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AUTHOR Hussain, K. M.
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ABSTRACT

The components of an information system for institutions in higher education are described. The information produced from such a system will be that which is required not only for record keeping and operations but also for planning and budgeting. Technical details are not included, only an overview of the main components of the system as seen from the user's viewpoint. The need for a data bank and a strategy for developing it are examined, followed by a description of the set of models and instructions necessary for data processing. The use of the instructions regarding record keeping, planning, and budgeting is discussed. Specific cases are cited in the final section: one from Europe, HIS, and the other from the United States, NCHEMS. Detailed flow charts are included. (LBH)

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PROGRAMME ON INSTITUTIONAL
MANAGEMENT IN HIGHER EDUCATION

PROGRAMME SUR LA GESTION
DES ÉTABLISSEMENTS D'ENSEIGNEMENT SUPÉRIEUR

# TOWARDS A TOTAL INFORMATION SYSTEM FOR OPERATIONS, PLANNING AND BUDGETING IN HIGHER EDUCATION

K.M. HUSSAIN
II.

PROFESSIONAL SEMINAR

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# TOWARDS A TOTAL INFORMATION SYSTEM FOR OPERATIONS, PLANNING AND BUDGETING IN HIGHER EDUCATION

by

K.M. HUSSAIN
New Mexico State University

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## SECTION ONE: INTRODUCTION

The purpose of this paper is to describe the components of an information system for institutions in higher education. The information produced from such a system will be that which is required not only for record keeping and operations but also that required for planning and budgeting.

The audience of this paper are administrator and managers of higher education. Therefore the discussion will not go into any technical details of designing or processing of data nor into the mathematics of any models discussed. Instead, it will provide an overview of the main components of an information system as seen from the viewpoint of the user of the system. There will, however, be relevant citations for the reader interested in further study.

The sequence of topics to be discussed is as follows: Section two, the next section, will examine the need of a data bank and a strategy for developing it. Section three will describe the set of models and instructions that are necessary for the processing of data. Section four will discuss the use of the instructions described in Section three to process the data bank developed in Section two in order to generate the reports necessary for record keeping, planning and budgeting. Section five, the final section, will be on cases. Two case studies where such information systems are being developed will be examined. One is from Europe: HIS; and one from the United States: NCHEMS.

## SECTION TWO: DEVELOPING A DATA BANK

A data bank is a set of integrated data used in computer processing. The data itself is typically organised by functions and referred to as files. But the data must be integrated so that it meets the needs at all levels of the organisation. These needs of data will now be discussed followed by a discussion of the strategies of integration.

### 2.1 Data needs of an Institution

Data is required for three purposes: for operations and record-keeping; for control, and for planning. These needs correspond roughly with the structure of the organisation as shown in Figure 1.

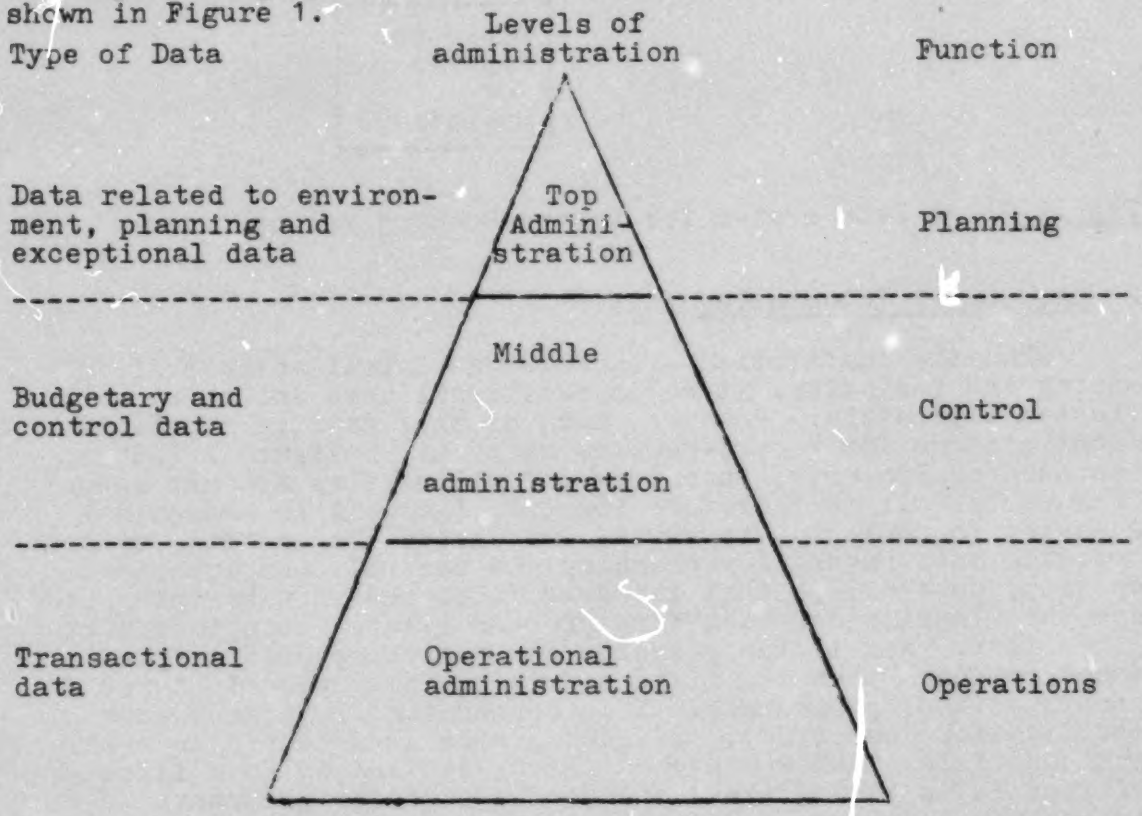


Figure 1: Relationship of type of data to levels of organisation and functions of administration

Most information systems in higher education are for purposes of record-keeping and operations (the lowest part of Figure 1). Typically, they consist of a set of separate functional files as shown in Figure 2 and produce lists and reports needed for daily operations.

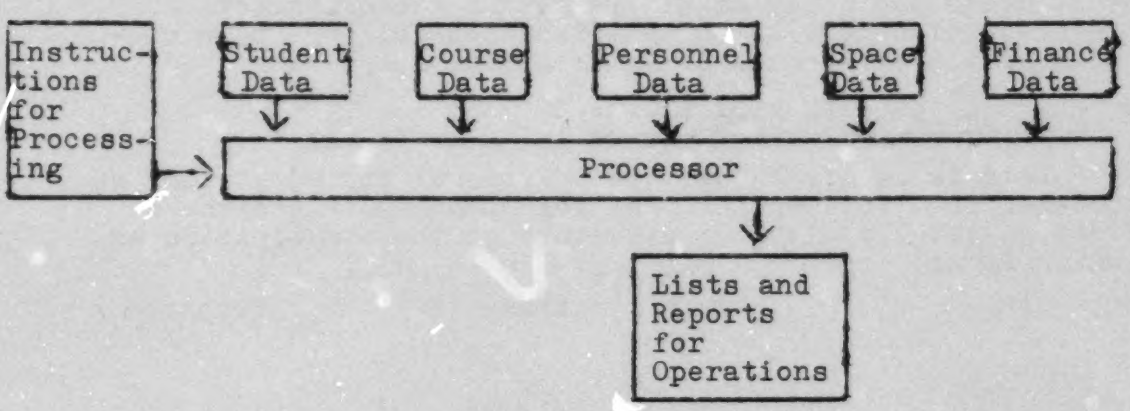


Figure 2: A Data system for record-keeping and operations

## 2.2 Horizontal Integration

When the institution wishes to use formal methods of planning and budgeting, it needs additional data and this can be collected separately. However, much of this data is available in most systems for record-keeping as shown in Figure 2 (other files such as Property, inventory and Allummfiles are not shown in Figure 2). It is therefore logical, (as well as economical and easier to control), to expand and extend the existing system as provide data needed for planning and control. An important condition, however, is that the data files must now be integrated since the planning and budgeting process relates to all or most of the files. And if the planning and budgeting uses a "programme" approach then the files should be integrated in terms of institutional programmes. This can be done by a programme classification code (PCC). If such a code is included in each functional file, then we have an integrated set of data files (referred to as a data bank) and can be used for programme planning and budgeting. This is shown in Figure 3. The system could be used as follows: for each programme such as an instructional programme, the output (students) can be identified from the course file; the student characteristics (such as major) can be identified from the Student file (for that programme using its PCC); the personnel required can be found on the Personnel file (again for the programme using its PCC); the space from

the space file and expenditures from the finance file. This gives all the data required for calculating resources and output (if measurable) for each programme. Such integration of data within an institution is sometimes referred to as horizontal integration(1).

A programme classification code for higher education should include a classification of each academic discipline. Most countries have such a classification. In many countries each state also is interested in a classification and has one of its own. Thus to avoid those classifications (one each for the institution, state and nation) it is very desirable to have the national and state academic classification incorporated in the programme classification code (PCC). This relationship is shown in Figure 3. (Other components of figure will be discussed below.)

There are some nationally adopted Programme Classification codes. One is currently being used in the United States (Gulko 1970), another has been developed in Canada (Clardel 1972) and yet another is currently being developed in Holland.

Another criterion for a good integrated system is that there must be a standardization of terminology. A data item that occurs in more than one file, should be defined alike. This can be done in a Data Element Dictionary (D.E.D.), one for each file. This too is shown in Figure 3.

## 2.3 Integration at all levels of planning

The data element dictionaries could be institutionally defined, but if the output is to be used inter-institutionally (by the institution or at higher level such as a state or federal agency) then the dictionaries should be designed in close co-operation with such agencies, or typically, the institution will participate with other agencies in designing such dictionaries. Alternatively, dictionaries could be designed by both, institutions and agencies: the institution design, its dictionaries for record-keeping and co-operates with other agencies for dictionaries concerned with planning and control. This has been the experience with NCHEMS in the United States (Thomas, 1970). In Germany, in contrast, HIS has developed data dictionaries for record-keeping and plans to expand it with data definitions for purposes of control and planning.

The integration of the institutional data bank with other agencies using its data is an example of vertical integration. Part of such integration will require that definitions used by

(1) For more on this subject, see T.R. Mason (1970). For a text on developing information Systems, see Hussain (1973). On problems in developing an information system in Berlin, see Klose (1972).

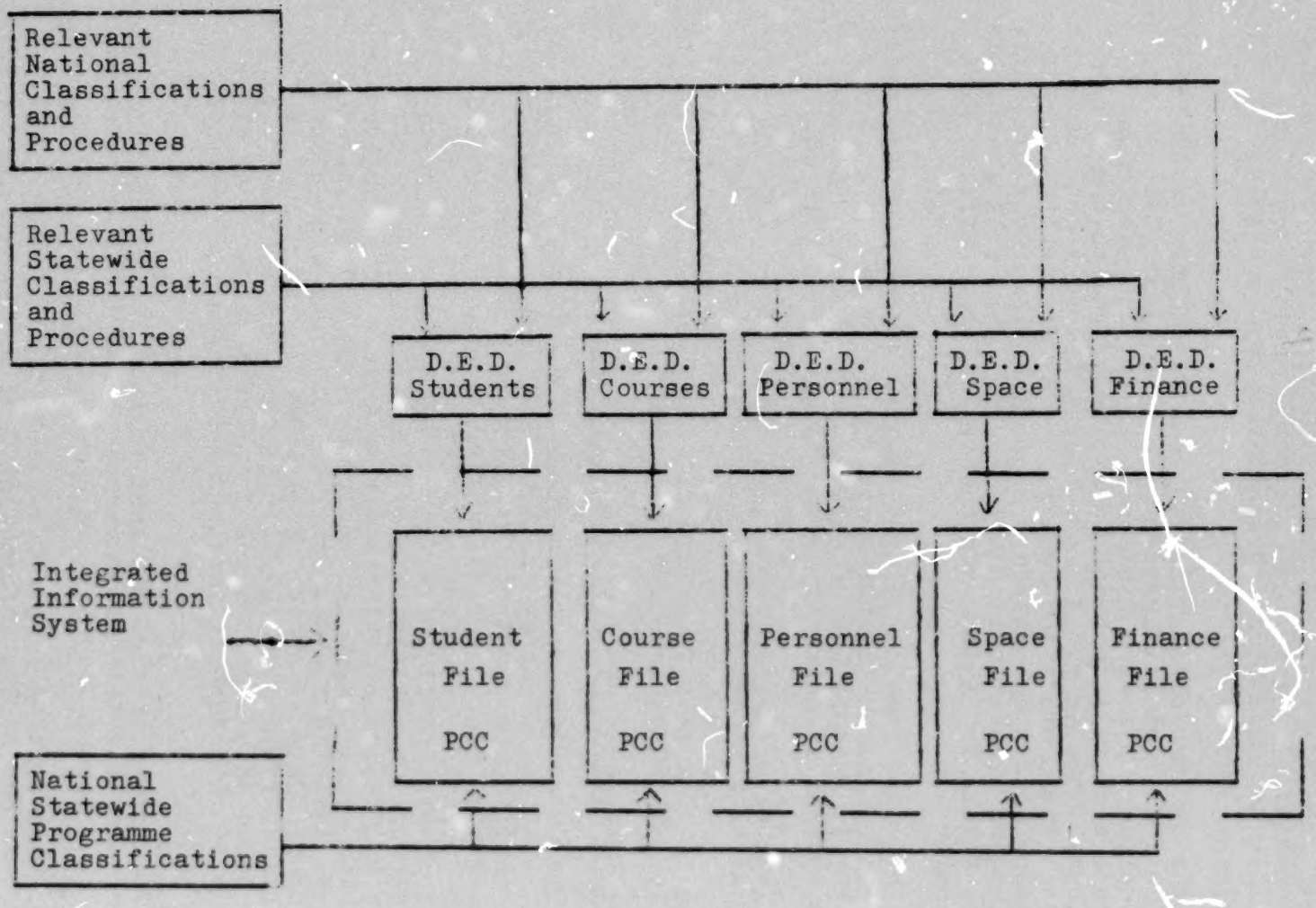


Figure 3: Development of a Data Bank integrated at all levels of decision-making

state and national agencies be incorporated whenever this is relevant and necessary. For example, consider the Personnel file. If its output is to be used for national manpower planning, then the personnel file must be compatable in its definitions, with the national manpower classification. Similarly, the space file and the Finance file must be compatable with the state and national classification and methodology procedures of analysis for space and finance respectively. These inputs to the Data Element Dictionaries are shown in Figure 3. The inputs will of course vary between countries and even between states within a country. In some cases the data may be too inconsistent and can not be easily integrated. Then one must pay the price of having incompatable and incomparable data.

2.4 Longitudinal integration

Yet another type of integration necessary for planning purpose is "longitudinal integration" that integrates data over previous time periods. Such integration is necessary for purposes of prediction as well as for control.

The above types of integration provides integrated data referred to as a data bank as depicted in Figure 3.

## SECTION THREE: MODELS FOR COMPUTATION

### 3.1 Models

Given the inputs of Figure 3, we now have a data bank and we can now generate information - i.e. processed data. In the case of a Record-Keeping-operational System, the processing is mostly rearranging of data and some calculations. In the case of a Planning, Budgeting (Control) System, the computations can be many and complex. The rules of the computation then have to be described. Also, the structure of the organisation and the relationship between relevant variables must be described. This description can be called a model. It is a representation of reality. And for each set of computations, we can have a different model. Thus typically, for a Planning and Budgeting system we do have a model for Resource Prediction, a model (or a set of models) for student enrolment projection and flow and a model for calculating benefits and performance. To make the results comparable it is necessary to follow a set of principles and procedures for budgeting for space analysis and for costing. These models, principles and procedures are all shown in Figure 4. Each will now be discussed briefly.

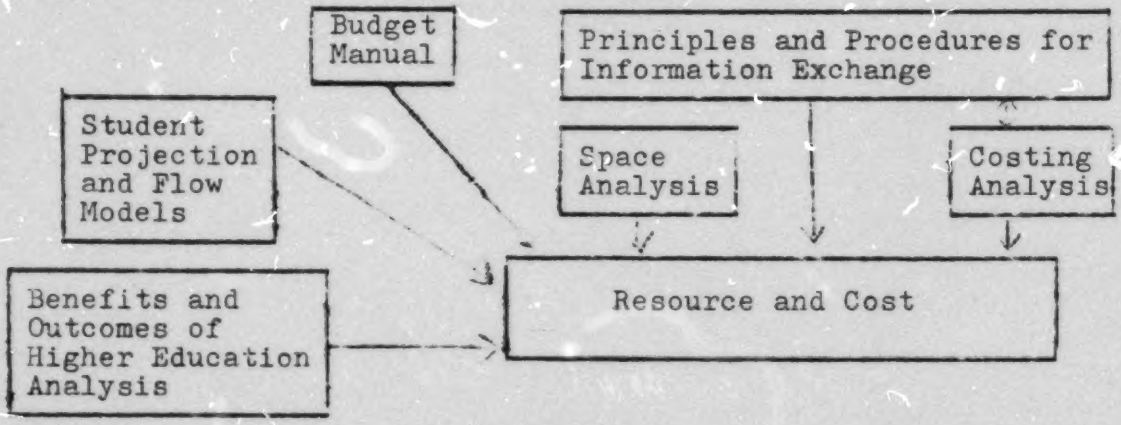


Figure 4: Models for Planning and Budgeting in Higher Education

### 3.2 Resource and Cost Model

The most basic and important of the planning and budgeting models is the Resource and Cost Model. It calculates the budget for next year and a long range plan for the next 8-10 years. It also calculates the cost of each programme and the resource and cost implications of changing programmes.

There are many such models that are operational. The most used is RRPM (Gulko and Hussain, 1971; Hussain, 1971; Hussain and Martin, 1971; Clark et al., 1972). It is developed by NCHEMS (the National Centre for Higher Education Management Systems) in the United States. The most comprehensive and detailed one is CAMPUS, developed under a Ford Grant in Toronto, Canada (Judy 1969 and Levine 1969). Other operational models are: HELP/PLANTRAN (Sutherfield 1971 and McKelvey 1970); CAP: SC/SEARCH (Keane and Daniel, 1970); HIS Modelle A and B (Dettweiler and Frey, 1972)(1); the work at Nijmwegen, Holland (Goossens, 1971); the work in Copenhagen (Jensen, 1972) and the TUSS Model at Utrecht, Holland.

## 3.3 Benefit-Cost Models

The models discussed above are resource or cost models. They do not calculate the benefit-cost ratios of any programme. This is not because this is not desired, but because we are unable to do so. We do not have the technology to measure the outcomes, benefits and performance of education. And this is not because of a lack of effort. Much work has been done on this subject both in the United States (Keller 1969, Lawrence et. al. eds. 1970) and in Europe, on returns to education (Psacharopoulus and Huchliffe 1973). This is an area of great importance and the subject of study by a national Task Force at NCHEMS in the United States.

## 3.4 Student Models

Whether we use a cost model or a benefit-cost model, we do need data on the number of students in each student programme by level of student. This can be determined by a student Flow model given projections of new student entrants(2).

Student Flow models are sometimes part of a Resource Model such as CAMPUS, NIS, TUSS and SEARCH. In other cases, like the RRPM, it is separate but designed to interface with the resource model. In most resource models, the student Flow model is independently the resource model. This is desirable because there are many student Flow models. A study done by Lovell (1971) identified 19 such models. Some worth mentioning are: Young and Almond (1961), Cani (1963), Stone (1965), Oliver (1968), Perl and Katzman (1968), Oliver and Marshall (1969) the Working Group for Empirical Research (Freytag et. al. 1969), Casper (1969), Dietze (1969), Sandell (1971), Marshall, Oliver and Suslow (1970), Newton (1970), Smith (1970) and Turksen (1970).

All student flow models require as input the new enrolment. This can be done by an enrolment projection model which typically is a regression equation. But the need for such

(1) For a comparison of these models see Van Wijk and Russell, 1972. For a critique see Hussain, 1973 (a), Oliver 1971 and Andrew 1971 (a).

(2) For an empirical comparison of projection techniques, see Orwig, Jones and Lenning (1972).

projections has greatly decreased in Europe where numerus clausus is being increasingly evoked, and students are assigned to specific institutions (for procedures in Sweden, see MacMurray and Göran Svanfeldt, 1969, for Germany see Böckling 1973).

## 3.5 Space Analysis

One reason for numerus clausus is the limitations of physical capacities. This requires that one calculates the physical capacity given utilisation factors. These factors need to be defined along with procedures for determining them and analysing them. Often space is typically used by more than one programme and the space resource consumed have to be allocated to these programmes. The allocation rules have to be stated. These rules are important for calculating unit costs and operating budgets. But in addition we need rules for projecting space needs for this determines the capital budget.

There are many manuals for such space analysis. One has been developed by NCHEMS (Dahnke et. al., 1971). It (like the other modules discussed in this section) can be used independently of the Resource model or other models.

## 3.6 Budget Manual

There are other budgeting items besides space. The projections for these must be made according to specific guidelines and procedures. Specific documents must then be generated that will display and summarise information according to desired format and nomencalture. All these are stated in a Budget Manual.

One such manual is being developed by NCHEMS. Meanwhile, there are many recorded examples of the use of such manuals and models in the United States (Balderston and Weatherby, 1973; Weathersby and Balderston, 1972); in Canada (Marshall 1968); and in Sweden (Hammar 1968, Appelquist, 1971).

## 3.7 Costing

There are many components to the process of costing. These are shown graphically in Figure 5. Each component will now be discussed in turn.

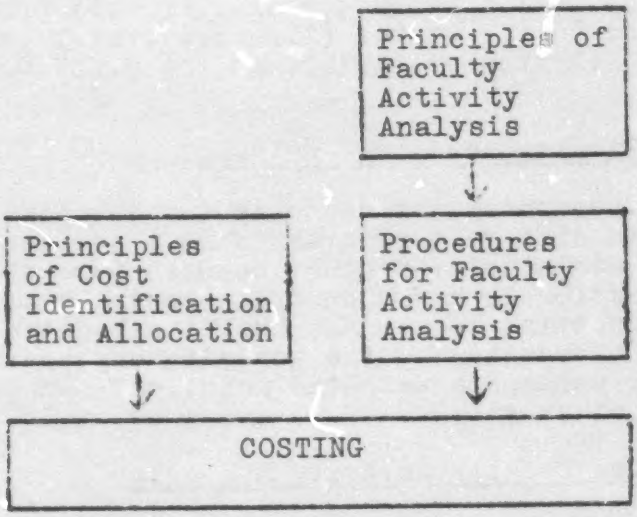
Principles of Faculty Activity Analysis
Principles of Cost Identification and Allocation
Procedures for Faculty Activity Analysis
COSTING

Figure 5: Principles and Procedures for Costing

3.7.1 Identification and Classification

The first step to costing is the identification of costing elements. In some cases there are problems. For example, consider the acquisition of a book by a department. Who should it be charged to? The department? Or the library? The choice may seem inconsequential for an institution but it is important if costs are compared between institution. Then it becomes necessary to precisely define each cost component.

Once cost items are identified and costs are determined then there is a problem of allocating costs to the users. For example, let us continue with our example of the library. How should the library expenses be allocated? In proportion to the students or faculty in each programme? Or should it be in proportion to the books used or number of users of students and faculty? (If any answer is yes, this raises problems of measurement!) Or should it be in proportion to the academic level of programmes using the library? Or perhaps a weighted function of all these variables? If yes, then what are the weights?

A computer programme has been developed by NCHEMS for experimenting with different weights and different variables (Beaty, Fr. 1972). Using this programme to simulate, different allocation rules could help identify relationships that are politically acceptable and economically reasonable. These rules could then be used in Resource and Cost Models such as RRPM and CAMPUS.

There is much work done in the area of cost principles, and costing. In the United States (Ziemer et. al., 1971); in England at Bradford (Bottomley, 1972); at the O.E.C.D. (Legge 1971).

3.7.2 Principles Faculty Activity Analysis

An important component of costs is the faculty. Associating his costs to different programmes is a serious problem since he typically has a joint-product between more than one programme. The question is how should his costs be allocated? Should it be in proportion to how the budget allocated its funds; or should it be in proportion to the activity expended for each programme? Or perhaps a weighted function? Or perhaps in proportion to some other rule?

3.7.3 Procedures for Faculty Activity Analysis

These are problems of cost principles. Once this is decided, we then have a problem of procedures, especially when the rule chosen is the proportion of time spent by faculty. The problem is: how to determine this time spent? Should the faculty be asked to state the proportions or should the department chairmen be asked? Or perhaps both? And how should the effort be determined: in hours spent or percentages of total week work-load? These questions have been raised by many institutional researchers over the years. A survey (Romney 1971) identifies 44 several studies that were almost evenly split in their answers to the above questions. But there is a need for concensus as to an acceptable method. One attempt is a project by NCHEMS (Baugham et. al., 1972). It will test a set of forms and procedures and hopefully it will be generally asserted.

The need for procedures and principles of costing was long recognised in the United States and was one of the most important reasons for the founding of NCHEMS. It is a task that is now in progress [Romney 1972 (a)].

3.8 Information Exchange Principles

Costing information as well as other planning information is often required for exchange between institutions. The information could be used for planning, say, of a new degree, already offered by another similar institution, but before this can be done it is necessary that such information be exchangeable between institutions. There is another reason for comparability. It is desired by agencies above the institution. They require such information not only for evaluating and

assessing accountability, but also for purposes of planning at its level. The output of the institution becomes the input for the higher level agencies. In multiple institution planning it is necessary that the information is comparable for all the institutions involved. Hence the need for comparable information.

In order that comparable data can be exchanged and used for higher level planning, it is necessary to agree on principles and procedures of exchange as well as the content of information to be exchanged. This would include the identification of data and its deviations (coefficients and indices) that need to be exchanged; the determination of the levels of aggregation; and the formats for reporting.

This concludes the discussion of the main models and projects concerned with instructions in a planning and budgeting system, as shown in Figure 4. Institutions may, however, find it relevant to add special models that are concerned with revenue and portfolio management; with scheduling of students (Oakford et. al., 1967 and Tomer 1969); with assignment of faculty (Dettweiler and Frey 1970); or models that calculate capacities (Redelberger 1969; Bessai et. al. 1969; Finkenstaedt et. al. 1972; Rumpf 1969; Heckenhausen 1966; Mahrenholtz and Withum 1969 as well as Menges and Elstermann 1970).

## SECTION FOUR: PROCESSING OF INFORMATION

The inputs and outputs for processing are shown in Figure 6. There are four main components: the data, the instructions for processing, the processor (equipment that processes) and finally, the output. Each of these components will now be discussed below.

### 4.1 Data

Much of the data required for planning and budgeting models can be found in the data bank used for record-keeping and some control. This was the experience of the eight pilot institutions implementing RRPM (Hussain and Martin, 1971, p. 9). But the data needs to be expanded - sometimes collected in greater detail; sometimes in the historical context and sometimes restructured by programmes rather than administrative units. Also there is additional data that is required by the planning models. This includes data on the structure of organisation (e.g. budget classification and cost centres); the planning variables and parameters (e.g. faculty load, coefficient of office space for each faculty by rank and staff); and finally, additional data required exclusively for the models (e.g. the volume of books in library needed to calculate the library costs).

There is another important characteristic of planning data. It is often highly processed data. An example is the Induced Course Load Matrix which is an important input to most resource models. In this matrix (table) each vertical column identifies the mix of courses required (input) to generate a number of given majors (output). This matrix can be generated from most files used for record-keeping but the matrix has to be calculated, analysed and often manipulated (e.g. averaged) in order to be stabilized. Such processing is typically done outside the resource model and then available in the data bank for input to the resource model.

The vertical column of the matrix discussed above is an important concept. The economist calls it a production function because it relates the input required for an output. But this is limited to instruction only. And there are other inputs and outputs to a higher educational institution: research, public service, resources for non-instructional (support) programmes as well as tuition received and other income earned.

These inputs and outputs must all be measured (when they can be measured) and related to each programme. This problem is the subject of a special project currently in progress at NCHEMS (Topping and Miyataki, 1972).

Given the data and the data bank, we now need the instructions for processing this data.

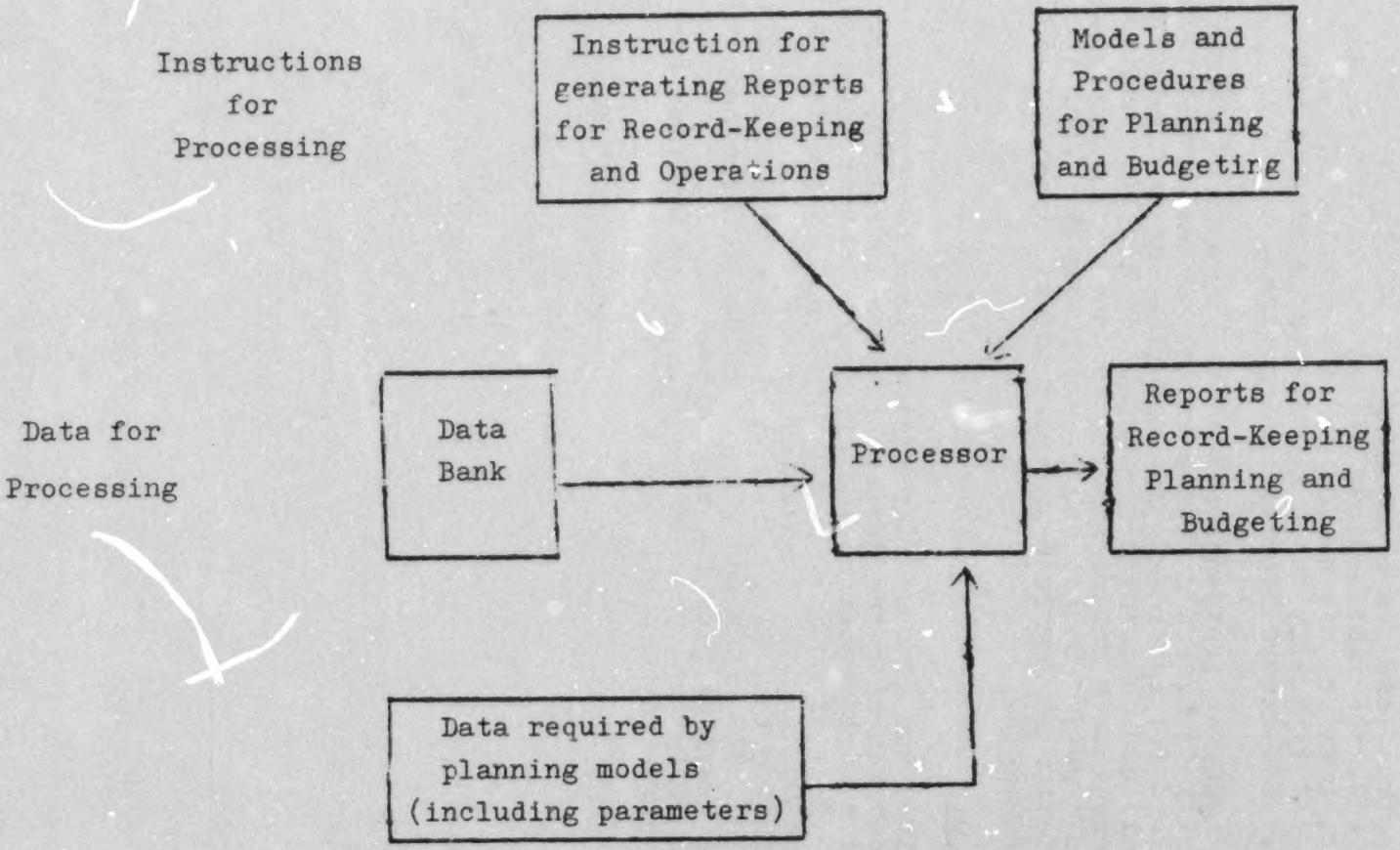
Instructions for Processing
Instruction for generating Reports for Record-Keeping and Operations
Models and Procedures for Planning and Budgeting
Data for Processing
Data Bank
Processor
Reports for Record-Keeping Planning and Budgeting
Data required by planning models (including parameters)

Figure 6: Relationship of Data Bank and models to planning and budgeting

## 4.2 Instructions for Processing and the Processor

Instructions for processing can be classified into two groups. One, the instructions needed for record-keeping and the other, instructions needed for the models. These could be combined but typically there are developed in an evolutionary sequence, with record-keeping coming first.

In many an institution that is large or is complex, it is necessary to have a computer as its processor and then the instructions for record-keeping and planning and budgeting (the model) are computer programmes. In smaller institutions, the processor is a set of pencils and paper, while the instructions are a set of Budget and Planning Manual. Thus the representation in Figure 6 is valid for all types of institutions and environments.

## 4.3 Output

Given the data and the instructions to process the data, we then can generate the desired reports as output. Now comes perhaps the most important and difficult part of the planning process. That of analysing the output and making the hard trade-offs. The models (those existing today) are not prescriptive nor are they optimising. Instead they are simulation models like CAMPUS, HIS, RRPM and TUSS which state the consequences of selecting a set of planning variables. The decision-maker must weigh the different consequences with their benefits (determined subjectively) and maks his choice.

## SECTION FIVE: APPROACHES TO AN INFORMATION SYSTEM

In this section we will examine two approaches to an information system in education. One is the work by HIS in West Germany, and the other is the work by NCHEMS in the United States. In each case, the history and structure of the organisation will be briefly discussed followed by a listing of the models and projects developed. This is followed by a brief critique comparing the two approaches.

### 5.1 HIS

HIS, the Hochschul-Informations-System was founded in 1969 as a private corporation with all the shares held by the Volkswagen Foundation. It was founded for a 4½ year period, whereafter it was to be continued as a public agency or terminated This decision has now been taken and HIS will be financed by the States (2/3) and the Federal Government (1/3) as of January, 1974.

The main purpose of HIS was to develop an information system and the rationalisation of university administration. The risks involved in the early stages were too great to be undertaken by the public sector and besides the financing procedures in the public sector are too slow. The educational system could not wait that long and hence the initial financing was through the private sector.

The objective of HIS was to develop a methodology and capability of a single integrated federal Higher Education System but within the overall European framework. The pressures of the real world and the power of politics, however, dictated that the early work was more in development of institutional systems in West Germany that would provide help at the operational level rather than in the area of planning and budgeting.

The organisation of the work of HIS is project-oriented and decentralised. Work is done largely on sites where the project is to be first implemented. The work is done by HIS staff working in a team with people from the site institution. The co-ordination as well as much of the development and programming work is done at the headquarters in Hanover. HIS, as of 1973, has a total of 96 professional employees and has a total expenditure of approximately 35 million DM(1).

### 5.2 NCHEMS

NCHEMS is an acronym for the national Centre for Higher Educational Management Systems. It was first conceived in 1965 but funded in 1969, in order to develop information systems for planning and management in higher education. Today, it has 800 members that include institutions and agencies of higher learning in the United States.

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(1) HIS 1971-1972, Report, pp. 150-153.

The institutions are very well represented in the decision-making hierarchy of NCHEMS. This is shown in Figure 7. In it the main design responsibility is that of a national Task Force (for almost all the projects at NCHEMS). This Task Force is supervised on technical matters by a Technical Council and on non-technical matters by an Executive Committee. These two groups appoint the Task Force and also select the pilot institutions. Their work (current work and future plans) are regularly debated and discussed by two other bodies: the National Assembly, that has representatives from all institutions participating actively in the work of NCHEMS; and the National Advisory Panel, that has representations from the United States Government, funding agencies and professional organisations in higher education. Through this network of committees, all the important interested organisations provide the necessary feed-back. The final decisions (on selection of Task Forces, Committees and even selection of models) are theoretically based on merit but the realities of power make some of these decision political decisions. The large states and the most vocal representatives often get their way. But such compromise is perhaps the price one must pay for consensus and agreement.

The cost of this national effort till the end of 1972 was nearly $5 million, of which 13 per cent is provided by non-profit organisations and the rest by the United States government. This cost includes the support of 35 professional staff(1) at NCHEMS but does not include the contributions made by institutions to pilot studies and to Committee work. All institutions that are "active" members of NCHEMS are obliged to contribute the time of their personnel on a "as-needed" basis. The institutions are also responsible for the local implementations except in cases of pilot institutions in which case NCHEMS provides the seed-money. In the case of the 8 institutions implementing RRPM, this came to 8.5 per cent(2).

### 5.3 HIS and NCHEMS

Both HIS and NCHEMS have a number of projects and models. These are listed in Figure 7 and 8 respectively. A few points of differences that are not apparent and will now be discussed.

#### 5.3.1 Area of emphasis

The main activity at HIS is in developing institutional information systems for purposes of record-keeping. Even the data element dictionaries are so oriented. Also, it is processing oriented though the actual processing is done at and by

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(1) NCHEMS, Director Annual Report 1971-72, 1972 pp. 14 and 19

(2) Hussain and Martin (1970, p. 20).

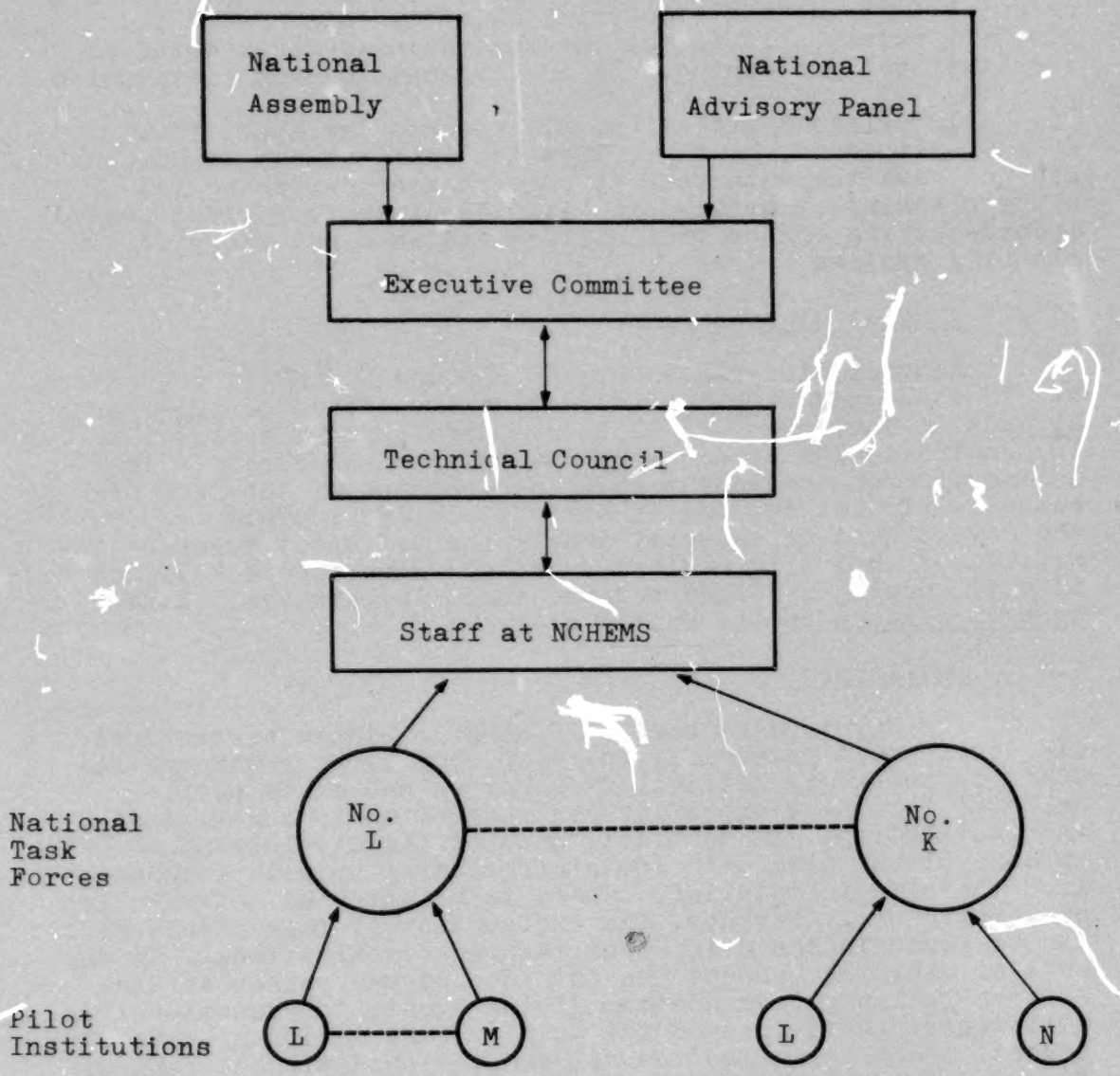


Figure 7: Organisation Structure for NCHEMS

the institutions themselves. Hence is interested in Data Management systems like MIS. In contrast, NCHEMS is planning oriented. Its data dictionaries identify data needed for planning models. It is not interested in record-keeping or institutional processing. It leaves that to each institution.

In original intention, HIS was not far apart from NCHEMS. It found, however, that the institutions in Germany did not have the data base to support record-keeping let alone planning. Furthermore, its administrators first wanted record-keeping and control systems and were not ready for planning systems.

5.3.2 Numerus Clausus

Another difference between HIS and NCHEMS is the effort of HIS connected with the increasing importance of numerus clausus in Germany. HIS is now developing the algorithm for centralised assignment of students to universities in Germany. Such assignment is needed because of the lack of capacity of institutions in many disciplines. This requires the development of capacity models for different types of institutions including medical schools. Such models have not been of any concern to NCHEMS because there is relatively little numerus clausus in the United States.

5.3.3 Development

The development work at NCHEMS is highly centralised. Its development personnel, however, come largely through its staff supported by National Task Forces and other people selected for their expertise and whose time is contributed by the institution. In contrast, much of the development at HIS is done at the site with its staff teaming up with personnel from the site institution. There is no national contribution or involvement. Perhaps, the explanation of this involvement can be found in the origins of the two organisations. In the case of HIS, the concept was the idea of one person working for the Volkswagen Foundation giving grants to educational institutions. He perceived the need of information systems for education and persuaded the Volkswagen Foundation to fund HIS for 4½ years. In the case of NCHEMS, the organisation is a result of genuine co-operation between many institutions; with the United States government paying the central administrative costs and the institutions contributing much of the pilot testing and all the implementation.

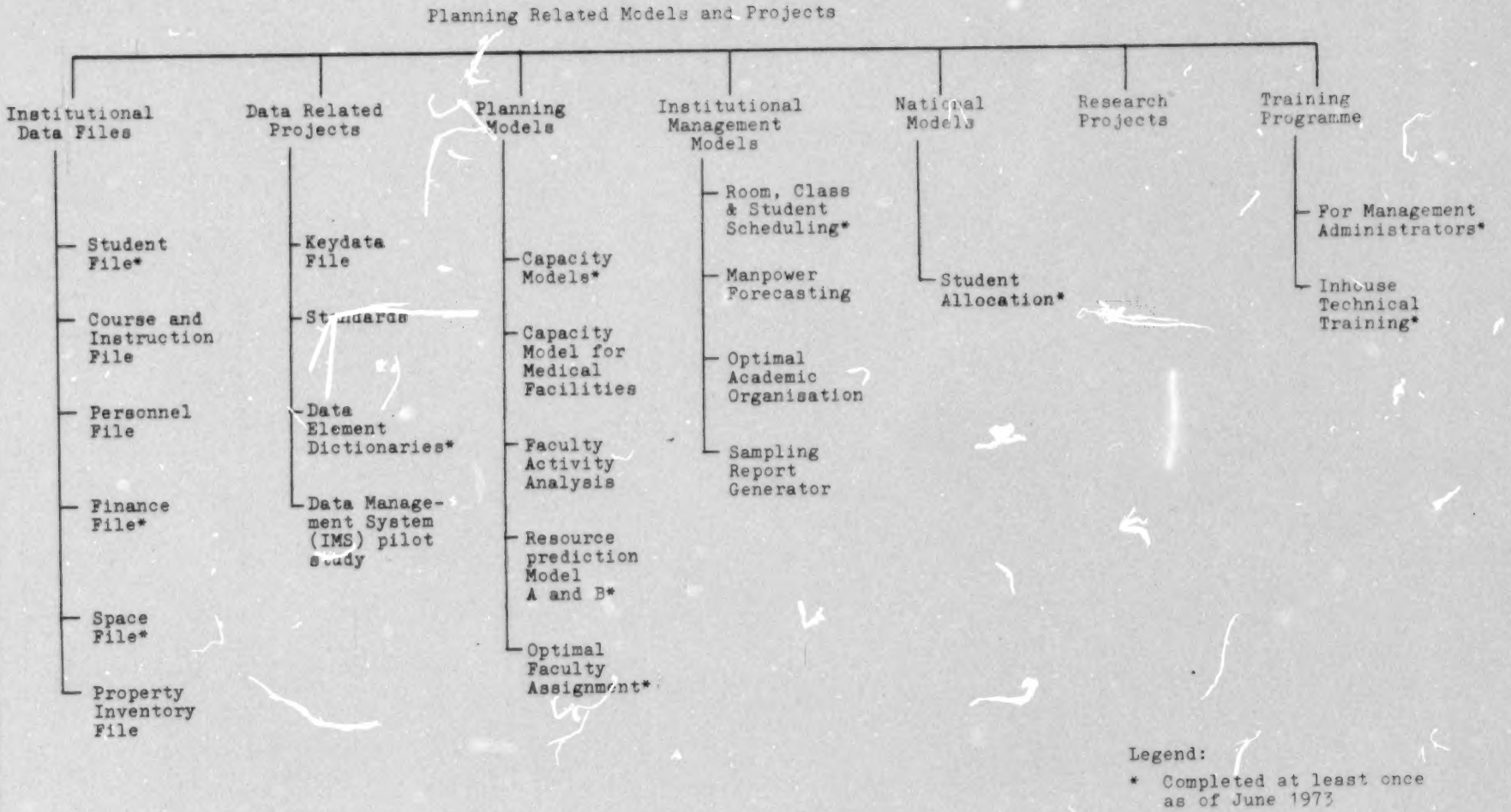


Figure 8: Information System Models and Projects at HIS (Germany)

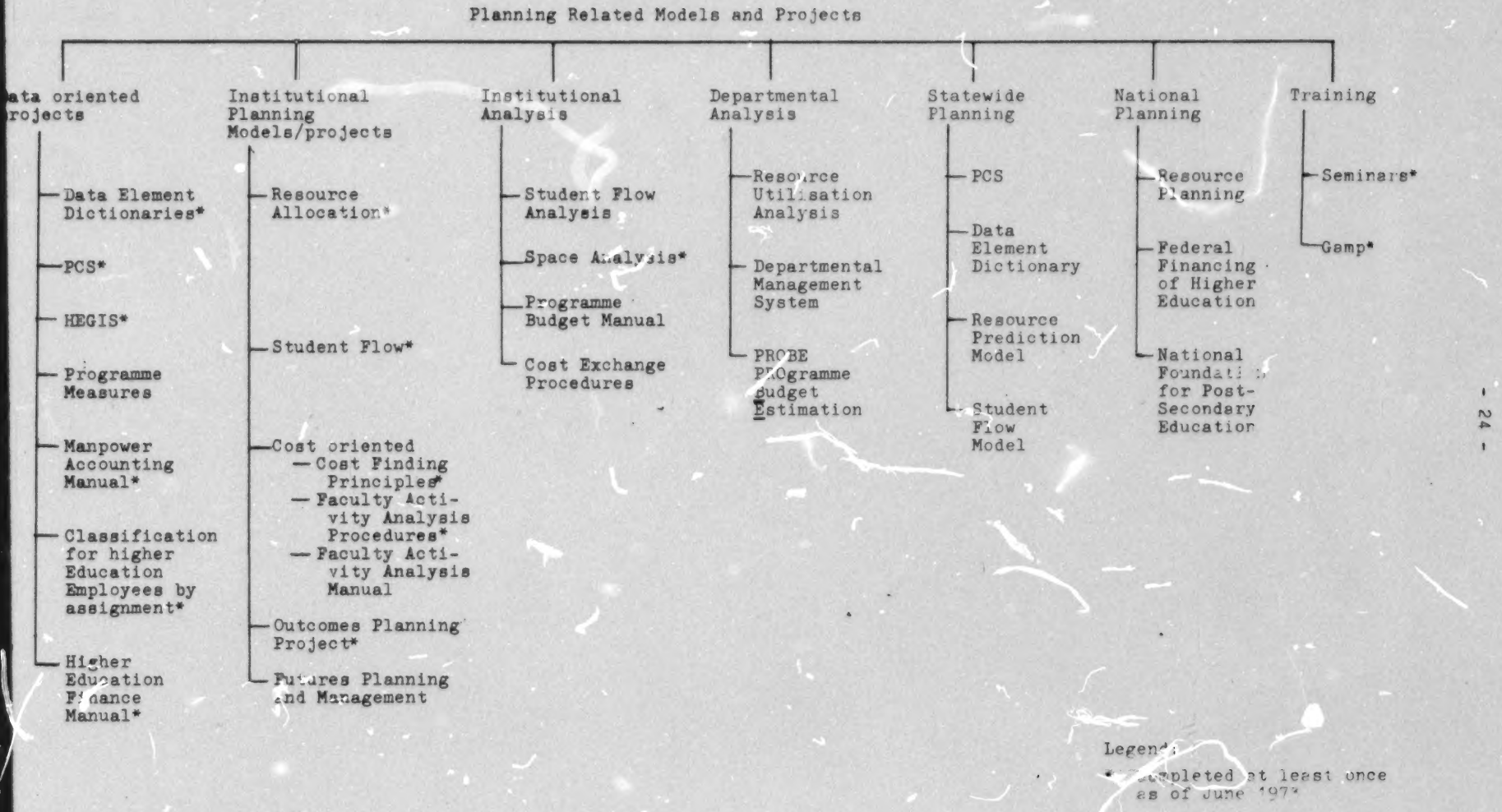


Figure 9: Information System Models at NCHEMS (United States)

5.3.4 Planning and Budgeting Models

Because of the diversion of the effort of HIS into institutional data system and models related to numerus clausus and also because it does not have institutional participation on a national scale, its efforts in planning models has been somewhat limited. It has a resource allocation model but this is restricted to instructional activities. Furthermore, the data for the planning model is collected separately and not from an integrated set of files used for record-keeping. In contrast, the NCHEMS effort in planning has considerable depth and scope; they are tested on a stratifield sample of institutions; and have wide application. Their effort is part of a well co-ordinated approach to an integrated system for planning and management not only horizontally integrated between the functions within an institution, but also vertically integrated at all three levels of: institution, statewide and national planning.

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